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BULLETIN No. 11.—1904.

BUREAU OF EDUCATION.

COURSES

IN

MECHANICAL DRAWING, WOODWORKING, AND IRONWORKING

FOR

PROVINCIAL SECONDARY SCHOOLS.

MANILA:
BUREAU OF PUBLIC PRINTING.
1904.

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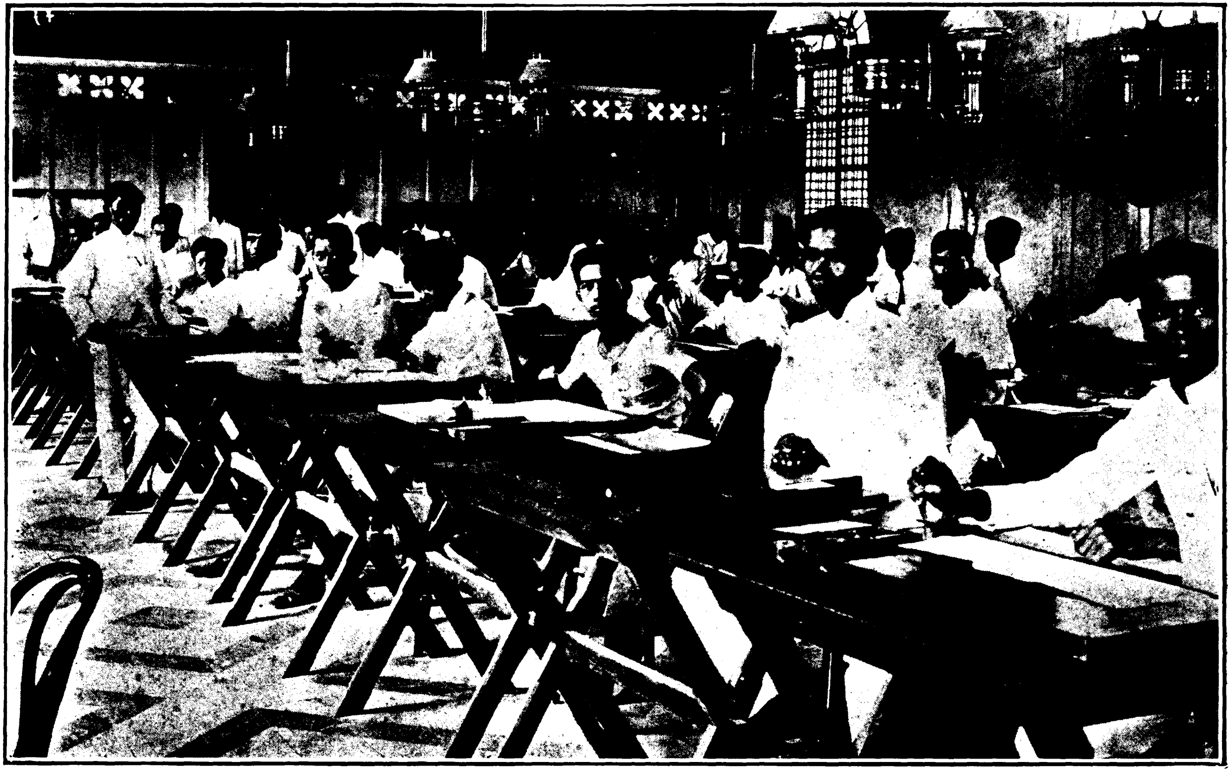

MECHANICAL DRAWING ROOM.

(Philippine School of Arts and Trades.)

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LETTER OF TRANSMITTAL.

MANILA, P. I., *June 13, 1904.*

SIR: I have the honor to submit herewith a bulletin containing a report and suggestive courses of instruction in mechanical drawing, woodworking, and ironworking for the provincial schools. The following members of the standing committee on industrial teaching have participated with me in the preparation of this bulletin: Mr. J. J. Eaton, secretary of committee; Mr. J. L. Davis, and Mr. Harry Hewitt.

Very respectfully,

RONALD P. GLEASON,
Chairman of Committee.

Dr. DAVID P. BARROWS,
General Superintendent of Education, Manila.

COURSES IN ARTS AND CRAFTS FOR THE PROVINCIAL SCHOOLS.

The following courses of instruction in mechanical drawing, woodworking, and ironworking are prescribed for students taking the work in arts and crafts in the provincial secondary schools.

The courses as outlined here cover two years, and give the student a fair knowledge of mechanical drawing and woodworking, or of mechanical drawing and blacksmithing and tool making. They further fit the student for entrance into the third year in the course of architecture, the course in cabinetmaking, the course in carriage building, the course in wheelwrighting, the course in wood turning and pattern making, the course in blacksmithing and tool making, the course for machinists, and the course in steam engineering, which can be completed, with the exception of the latter, at the Philippine School of Arts and Trades in Manila by two additional years of study. (See Bulletin No. 3, Bureau of Education, for information regarding Philippine School of Arts and Trades.)

Sufficient tools have been ordered to equip eight different schools with woodworking outfits, and the necessary drawing instruments and drawing materials for the same number have been provided; also enough ironworking tools for three schools.

These outfits are designed to accommodate 20 in a class, three classes daily, a total of 60 pupils per day in each course.

These equipments will be furnished to the provincial schools which first make suitable provision by the erection of shops. (See plans and specifications.)

The following outlines of work, the list of tools, and drawings of furniture are suggestive, and are intended to assist especially those who perhaps have had practical experience in the different branches but who have not had experience as teachers.

In working out the details of the various courses the teachers will, in a great measure, be left to their own devices for the present. Certain underlying principles should be taught, but owing to the varying local conditions the details will probably differ. If teachers desire it, the Philippine School of Arts and Trades will endeavor to furnish detailed courses of work.

With the coöperation of those teaching along the different industrial lines, a course of study can be evolved which may be uniform throughout the Archipelago. For this purpose teachers should submit their courses of work to the General Superintendent for reference to the committee on industrial teaching.

DRAWING.

It is estimated that a class of 20 in this subject is as large as a teacher can properly attend to, therefore instruments and supplies for a maximum class of 20 have been secured. An additional set of instruments, larger and more complete, is supplied for the use of the teacher and for such special work as he may think desirable.

INSTRUMENTS FOR MECHANICAL DRAWING COURSES.

These instruments are as follows:

Twenty sets of drawing instruments in case, consisting of one drawing pen, one pair of compasses with needle point, pen and pencil points, lengthening bar, one bow dividers, one combination bow pen and pencil.

Twenty triangles, xylonite, forty-five degrees, 5 inch.

Twenty triangles, xylonite, thirty-sixty degrees, 8 inch.

Twenty "T" squares, pear wood, 21 inches.

Twenty flat boxwood scales, 12 inch, metric and English.

Sixty drawing boards, 15 by 21 inches.

One set drawing instruments in case, consisting of two drawing pens, two compasses, large and medium sizes, each supplied with needle, pen, and pencil points, and lengthening bar, one medium dividers, one bow dividers, one combination bow pen and pencil, one wrench, one lead case.

One triangle, xylonite, forty-five degrees, 9 inch.

One triangle, xylonite, thirty-sixty degrees, 15 inch.

One "T" square, mahogany, fixed and adjustable head, xylonite lined, 36 inches.

One flat boxwood scale, 18 inch, metric and English.

One drawing board, 28 by 36 inches.

One set irregular curves, xylonite.

Two horn protractors, 5¼ inches.

One pair proportional dividers.

SUPPLIES FURNISHED FOR ONE YEAR.

The supplies for one year are:

Five quires Whatman's drawing paper, double elephant, hot pressed.

One ream drawing paper, second quality, Imperial, cut to 11 by 18 inches, hot pressed.

One dozen small bottles Higgin's waterproof black drawing ink.
Four half-pint bottles Higgin's waterproof black drawing ink.
One dozen small bottles Higgin's carmine drawing ink.
One gross lead pencils, A. W. Faber, Siberian (B).
Two gross lead pencils, A. W. Faber, Siberian (H).
Two gross lead pencils, A. W. Faber, Siberian (HHHH).
One hundred soft pencil erasers.
One hundred ink erasers.
One roll tracing cloth, Imperial, 30 inches wide and 24 yards long.
One gross pens, Gillot's No. 291.
Two dozen penholders.
One thousand thumb tacks.
One bottle machine oil.
One small oil can.
One small oilstone.
Two chamois skins.

The sets of instruments arranged for the pupils contain all the tools necessary for good work and are of a fairly good quality. The drawing pens, which are of great importance, are of the best quality obtainable.

Care of instruments and tools ought to be one of the first considerations of the pupils, especially in a country where the atmosphere contains so much moisture the greater part of the year. It is advised that the instructor make frequent examinations in order to assure himself that the tools are throughly cleaned after use, both of finger marks and ink. In addition, it seems necessary to dwell upon the fact that great care is required in adjusting spring instruments, in order to save unnecessary wear on the delicate threads; thus insuring greater accuracy and prolonging their usefulness. Complete instructions about the care and use of instruments are left to the judgment of the instructor.

The amount of work performed and the subjects studied depend to a certain extent upon local conditions, but it is advised that five hours a week as a minimum be devoted to drawing, and that all pupils studying this subject be given, for the first year, the same course of work. This should consist of various problems in plane geometry and simple work in orthographic projection.

Exercises of this nature have been thoroughly worked out and very well arranged by Mr. Linus Faunce in his book Mechanical Drawing. A copy of this book is sent as part of the outfit.

With this aid, if necessary, a course of work may be arranged consisting of both these subjects. It is considered desirable to pursue both at the same time, either alternating subjects—i. e.,

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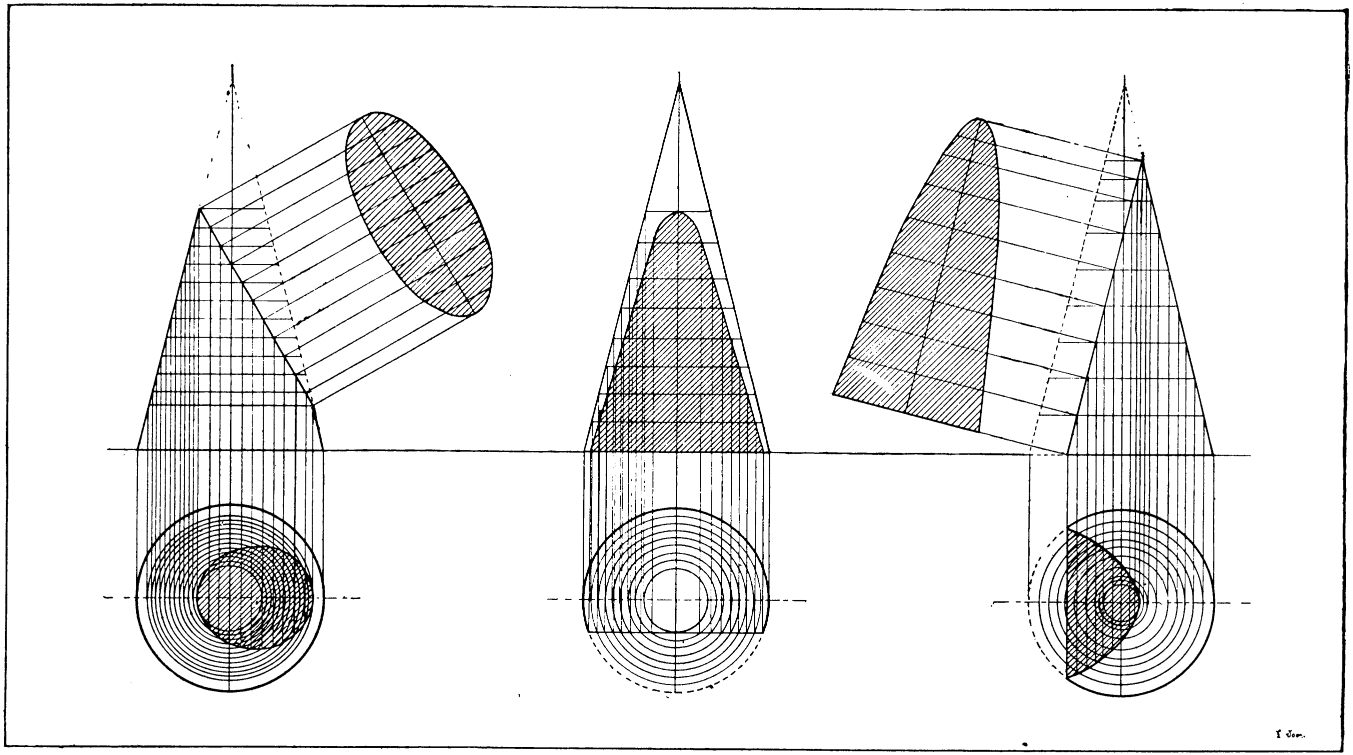


completing a sheet of one and then a sheet of the other—or taking up each subject on alternate days. More time should be given to projection than to geometry.

As the latter subject is given primarily for practice in the accurate use of instruments it would be well to impress this upon the pupil. In fact accuracy should be demanded all the time, even at the expense of shortening the amount of work performed.

Orthographic projection is but another name for plan and elevation, therefore it would be wise to add from time to time various simple working drawings. In this way the pupil will realize just what projection means and its final object. In order to make this last subject more clear, models of the various geometric solids, made of wood or card board, would be of great value. If these are used in connection with a model of the two planes of projection, illustrated by sheet 01, there will be less difficulty for the pupil to learn and the teacher to instruct.

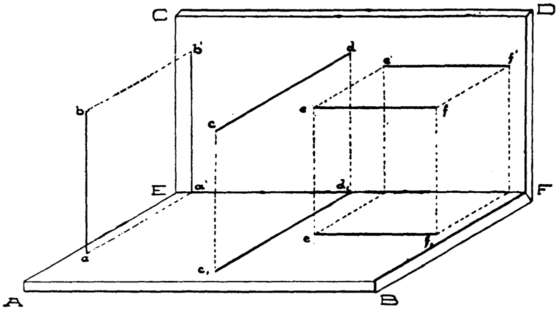
Scales, both metric and English, are supplied, but wherever possible, and there seems no reason why it can not be done in nearly all cases, the metric system should be used.

Suggestive drawings are attached showing the system adopted by the Philippine School of Arts and Trades. In this work the papers are 25 by 40 centimeters. This makes a convenient and desirable size for many classes of work. By taking this size as a unit, sheets for larger work may be arranged, such as 40 by 50 centimeters, and so forth. For this reason it is suggested that such a size be generally adopted in school work.

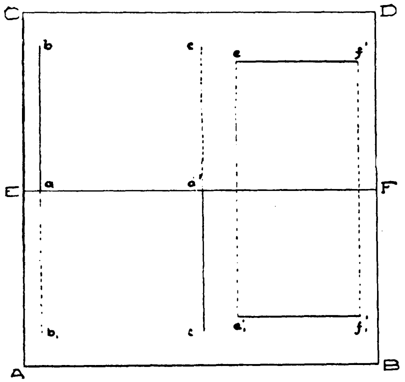
The sheets of geometry have a 2-centimeter margin except at the top where the title is placed. This upper margin is 3 centimeters. All given lines are medium width, resultant lines are heavy, construction lines are fine. Letters and figures are thus unnecessary. This sized sheet is easily divided into six equal parts, each part being a very convenient size for one problem.

In projection, models having the unit dimension of 5 centimeters may be very easily arranged upon a sheet of this size. All outlines of the solids are heavy, the ground lines medium, and the projection lines light. Center lines are dot-and-dash lines, and invisible lines are dotted. Many distinctions can be made with colored ink or different varieties of dotted lines, but the former are not suitable for tracings and the latter require time which might be more profitably used for other work. Perhaps it would be wise to reserve these methods for the second year.

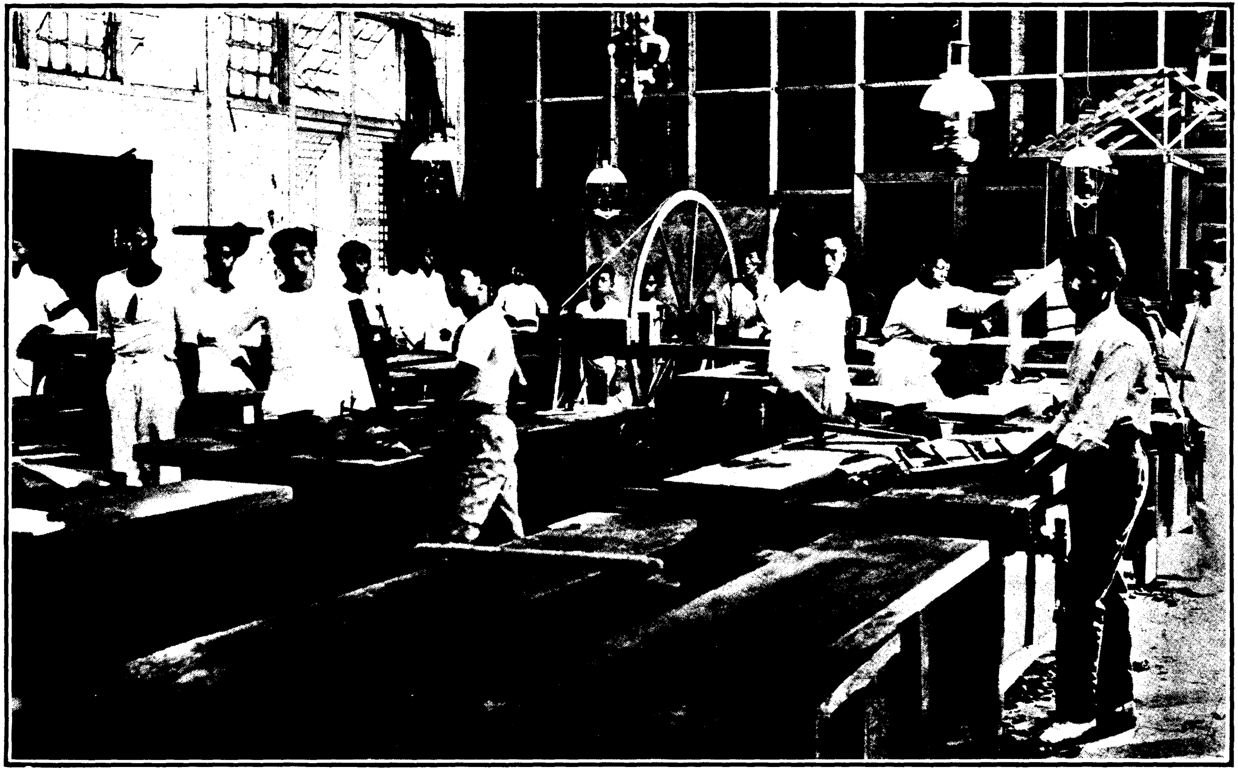
PLANES OF PROJECTION



VERTICAL PLANE REVOLVED INTO HORIZONTAL PLANE



(By I. Jose.)



WOOD-WORKING SHOP.

(Philippine School of Arts and Trades.)

Free-hand lettering is of such importance in adding to or detracting from the appearance of a drawing, it is advised that all spare time be devoted to this subject. For reference, the book, Free-Hand Lettering, by Mr. F. C. Brown, is supplied each instructor in drawing. This book contains many fine examples of different styles of free-hand letters, and should be of great assistance.

The drawings attached show a cheap, serviceable drawing table, a drawing board, and a combination instrument and drawing board cabinet. It is expected that all class-room furniture of this sort will be made at the school. There should be at least as many tables as there are pupils in the largest class. The combination instrument and board cabinet provides a place where all articles excepting the "T" squares, may be safely kept when not in use. Individual boards and pencils should be provided. The latter may be stored in the drawers of the instrument cabinet.

The most important items which require constant repetition in order that they may become impressed upon the pupil's mind might be embodied in the following set of rules:

(1) Keep the instruments clean.
(2) Keep the pencils sharp.
(3) Work accurately all the time.
(4) Ink curved lines first.
(5) Do not make holes in the paper either with compasses or anything else.
(6) Use one edge of board only for a guide.

Materials similar to those supplied with the instruments are kept in stock by the property clerk, Bureau of Education, as well as other articles which will be needed later, such as water colors, brushes, and so forth.

WOODWORK.

The course in woodwork should be decidedly utilitarian in character.

Utensils for the home, furniture for the house and school, toys and apparatus used in games can be made, and the fact that they can be used will add a decided interest to the work of the pupil.

One reason for the great interest in manual training in the United States is the fact that the product of the school can be used in the home. The parents are proud to exhibit the work of their boys or girls, and the children are equally pleased to show the product of their hands to their parents.

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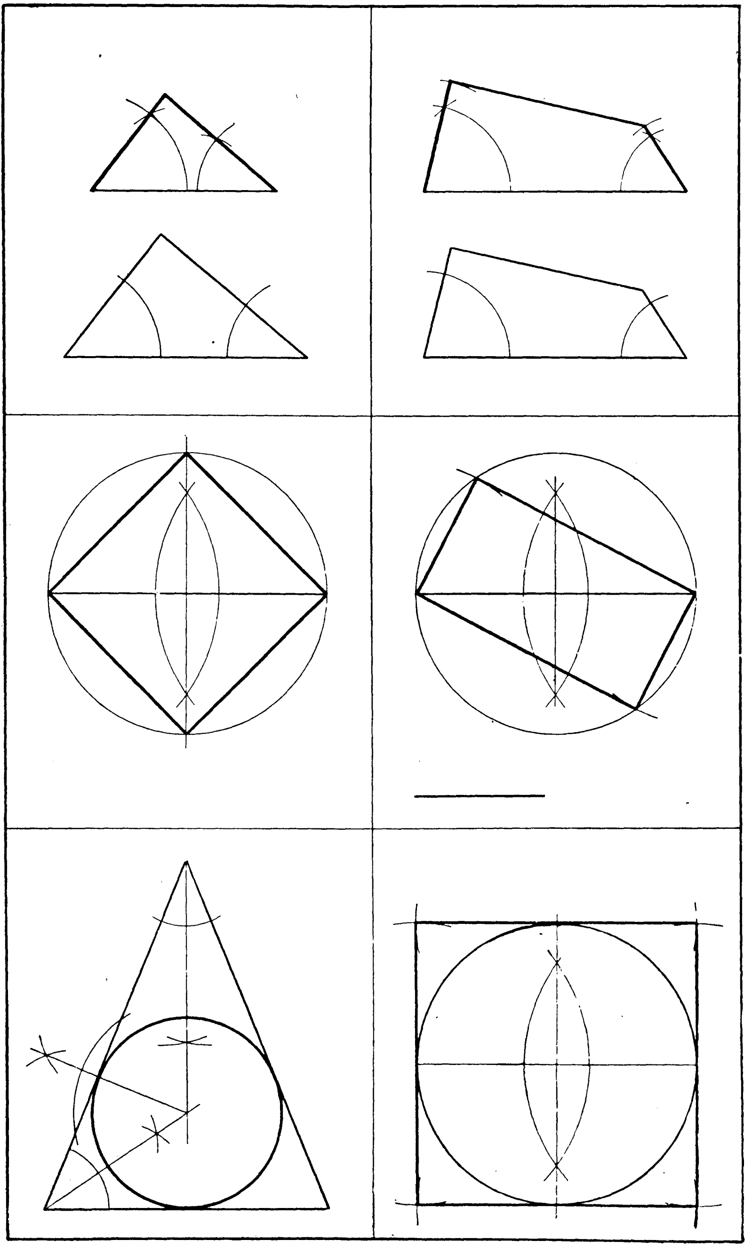
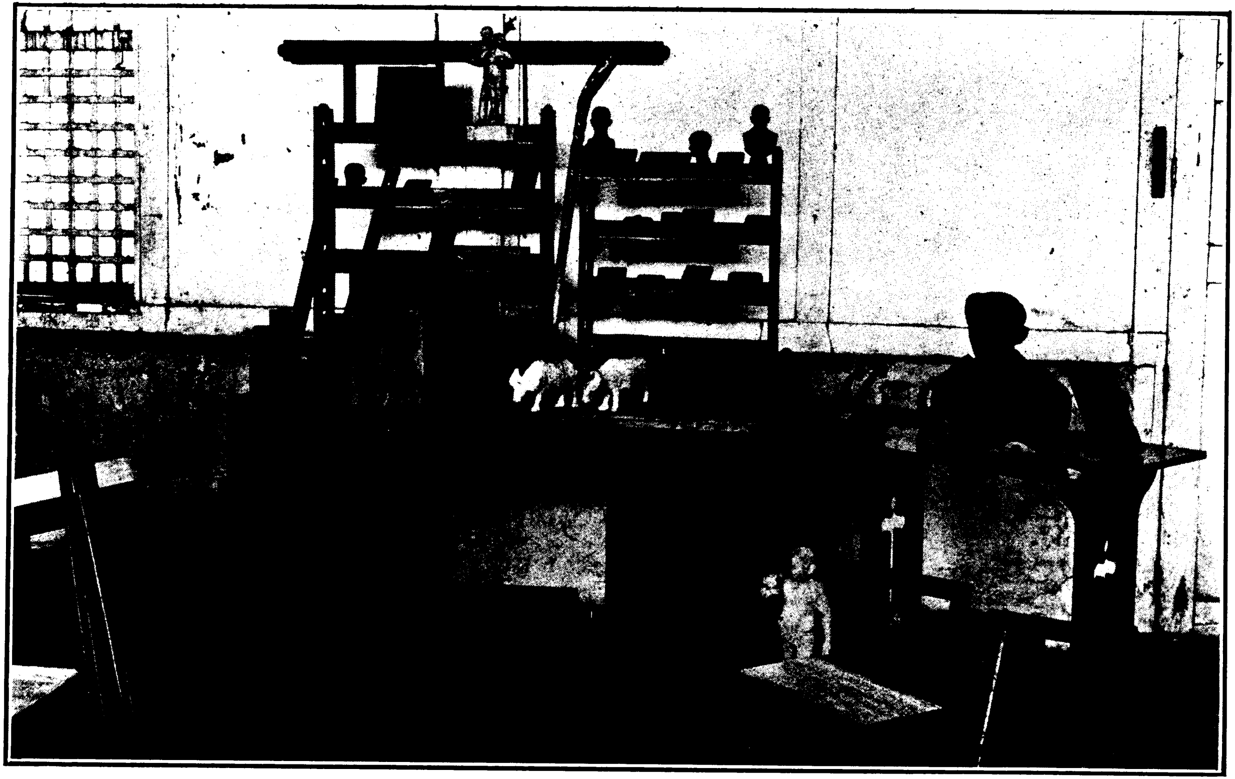


(By Amado Ignacio.)



SAMPLES FROM THE WOOD-WORKING CLASS.

(Philippine School of Arts and Trades.)

By making objects that can be of use in the homes, the parents will become interested and their coöperation secured.

The following is a suggestive list of articles that can be made in the woodworking shops: Rulers, boxes, towel racks, inlaying work, picture frames, knife trays, blotters, stools, book racks, shelves, cabinets, tables, pencil trays, wooden shoes, spoons. bowls, box kites, battledoor and shuttlecock outfit, checkerboards, and many tools and implements to be used in agricultural work.

The room should be provided with cabinets where the extra tools and materials can be kept under lock and key. Racks should be built for storing lumber out of reach of the pupils. Lockers for the individual students will be found of the greatest convenience. Here the unfinished work can be stored without danger of loss. This furniture can all be made in the shops.

All tools used at the bench should be carefully inspected at the close of each lesson.

Whenever any new principle is to be taught, a demonstration lesson should be given by the instructor so that the pupil may have an ocular demonstration of the proper methods to be employed in laying out the work, the proper manner of holding the tools for working, and the proper position in which to stand.

Too much care can not be exercised in this last respect. No one can do satisfactory work in a cramped and awkward position.

Care should be exercised to have the pupils use the tools properly and for the purpose for which they were made. Rules and marking tools should not be used as levers, the try-square not as a hammer or screw-driver, nor the dividers as a boring tool.

Do not strike a chisel with a hammer, but with a mallet.

The top of the bench should be kept true and clean. A cutting board on which the student can chisel should be made.

Each tool should have its own place, where it should be kept when not in use. All edged tools must be separated and carefully laid away so as to prevent injury to the edges. Planes should be laid on their sides, and chisels with the bevel down.

Tools should be carefully protected from moisture and especially from perspiration. They should be wiped off frequently, and oil or cosmoline applied.

The following instructions have been found advantageous in woodworking classes:

GENERAL INSTRUCTIONS.

(1) Pupils must first measure their stock, in order that they may ascertain whether the model can be made from it.

(2) Use pencil only for construction lines and marking working face and working edge.

(3) Cutting lines at right angle to grain of wood to be laid out with try-square and knife; oblique to grain with sliding "T" bevel and knife.

(4) Cutting lines parallel to grain of wood to be laid out with marking gauge.

(5) Always work from the working face and working edge.

(6) Knife and gauge lines should be plain, but not deep.

(7) Do not continue knife or gauge lines where they are not required.

(8) All lines to be properly laid out before any cutting is done.

(9) Saw and chisel cuts must not overstep the center of the gauge or knife lines.

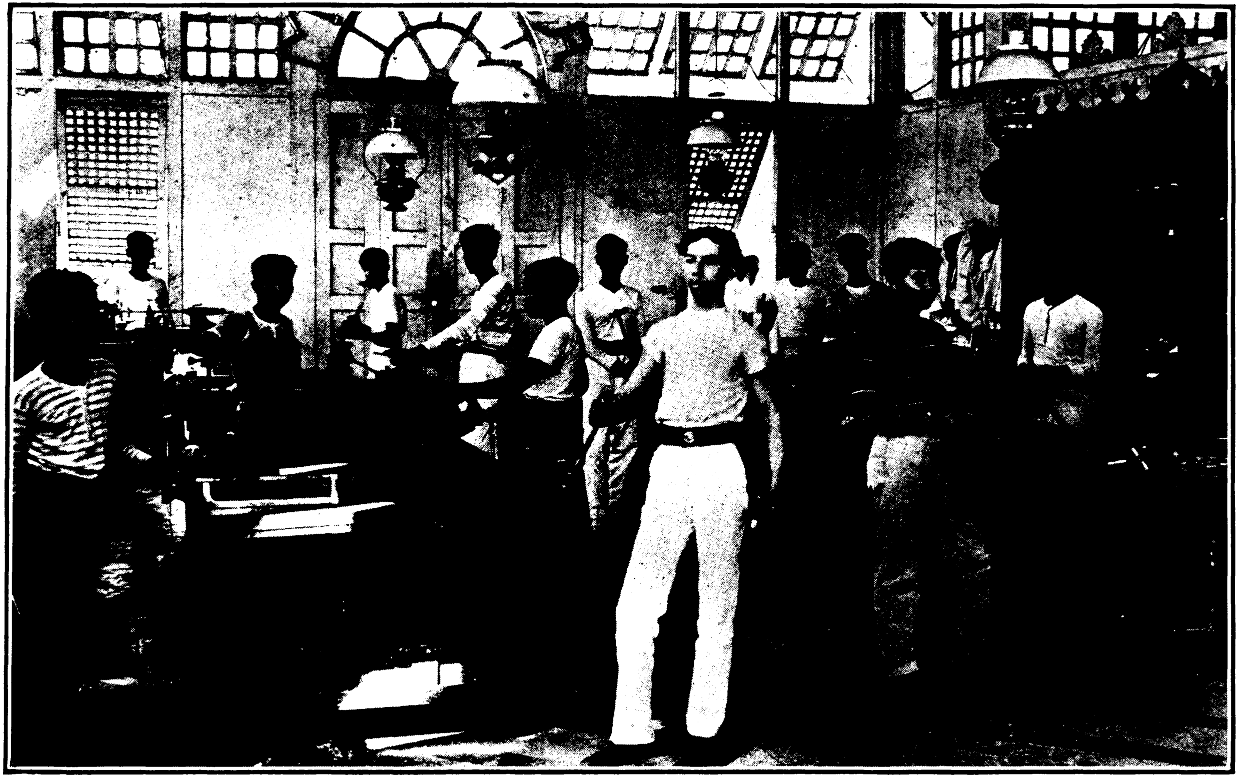
(10) Edge tools *must be sharp* to do good work.

(11) Never use a file or sandpaper in making a joint.

NOTE.—Special attention should be given to the following: (1) Dimensions; (2) laying out of the work; (3) cutting to the lines; (4) neatness.

STEPS IN PLANING SMALL WORK.

(1) Smooth one face of the stock.
(2) Mark face thus, X. This is called the working face.
(3) Square one edge.
(4) Mark on edge thus, II. This is called the working edge.
(5) Square one end with block plane.
(6) From squared end lay off proper length.
(7) Mark line with try-square and knife.
(8) Saw to line, leaving the impression.
(9) Block plane to knife mark.
(10) Set marking guage at proper width.
(11) From working edge gauge required width.
(12) Plane to line.
(13) Set marking gauge at proper thickness.
(14) From working face, gauge required thickness.
(15) Plane to line.



METAL-WORKING SHOP.

(Philippine School of Arts and Trades.)

EQUIPMENT FOR WOODWORKING SHOPS.

Twenty vises, wood worker's rapid acting.
Twenty bench screws, wrought iron, $1\frac{1}{4}$ diameter, 18 inches long.
Ten handsaws, crosscut, 10 points, 22 inch.
Five handsaws, rip, 7 points, 22 inch.
Twenty saws, back, 10 inch.
Twenty planes, fore.
Twenty planes, block.
Twenty hammers, carpenter's claw.
Five squares, steel.
Twenty squares, try, graduated in metric system.
Ten bevels, sliding "T."
Twenty dividers, wing, 6 inch.
Twenty gauges, marking, not graduated.
Twenty rules, 2-foot, boxwood, two-fold, graduated in metric system.
Three dozen files, cabinet, for wood, half round, 8 inch.
Ten chisels, socket firmer, handled, $\frac{1}{4}$ inch.
Twenty chisels, socket firmer, $\frac{3}{8}$ inch.
Ten chisels, socket firmer, $\frac{1}{2}$ inch.
Twenty chisels, socket firmer, $\frac{7}{8}$ inch.
Twenty gouges, firmer, outside bevel, 1 inch.
Ten braces, Barber's, 8-inch sweep.
Two dozen bits, twist drill, for wood, $\frac{4}{32}$ inch.
Two dozen bits, $\frac{5}{32}$ inch.
Two dozen bits, $\frac{6}{32}$ inch.
Two dozen bits, $\frac{8}{32}$ inch.
Twenty bits, auger, $\frac{6}{16}$ inch.
Twenty bits, auger, $\frac{8}{16}$ inch.
Twenty bits, auger, $\frac{12}{16}$ inch.
One dozen screw-drivers, Champion, 6 inch.
One dozen screw-drivers, Champion, 3 inch.
One dozen screw-driver bits, assorted.
One dozen counter sinks, snail, assorted.
One dozen nail sets, round point, assorted.
Two dozen files, saw, 3 square, $4\frac{1}{2}$ inch, slim taper.
Two dozen files, saw, 3 square, 5 inch, slim taper.
One dozen files, flat smooth, 10 inch.
Two awls, scratch.
One dozen clamps, Colt's eccentric, 4-inch open.
One dozen clamps, Colt's eccentric, 8-inch open.
Four clamps, Colt's heavy eccentric, 30-inch open.
Three hatchets, Hammond's broad, 4 inch.
Ten oilstones, India medium, unmounted, 6 by 2 by 1.
Four drawing knives, carpenter's, White's 8 inch.
Six spoke shaves.
Six file cards and brushes.
Four oilers, malleable iron.

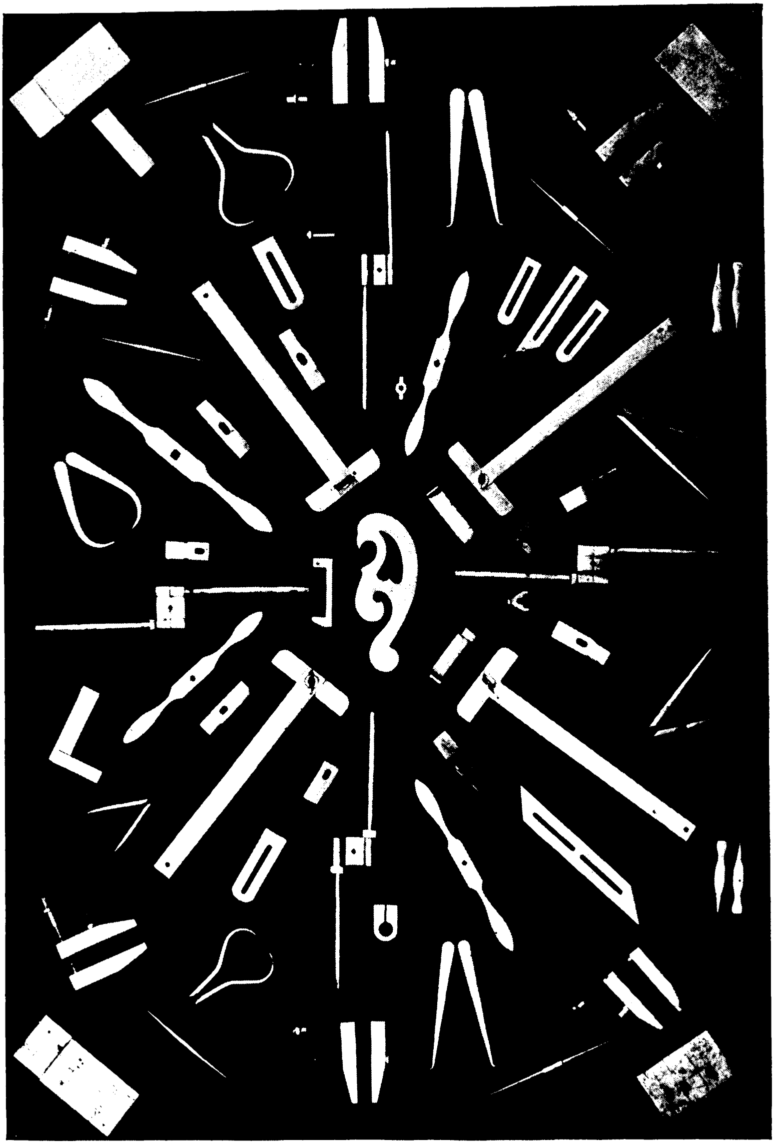
One dozen scrapers, steel cabinet, 3 by 4 inch.
Twenty Swedish Sloyd knives, 3-inch blade.
Twenty wood carver's knives, short blade.
One saw, crosscut, 24 inch, 12 points.
One frame turning saw, 14 inch.
Two dozen turning-saw blades, 14 inch, 3/16 wide.
Two nests of saws, complete.
One plane, Stanley's adjustable wood jointer, 26 inch.
One grindstone, 24-inch diameter, 2¾-inch face.
One set grindstone fixtures.
One saw set.
One lamp or oil stove, 4-inch wick.
One glue pot, 2 pints.
One pair pliers, black, 6 inch.
One wrench, knife handle, black, 10 inch.
One miter box and saw, 22 inch.
One brace, ratchet, 12-inch sweep.
One set auger bits, 4/16 to 16/16 inch, inclusive.
One set chisels, socket firmer, ⅛ to 2 inch, inclusive.
One expansive bit, large.
Two extra cutters for same.
One screw-driver, spiral.
One wing divider, 10 inch.
Fifteen pounds glue, flake, good quality.
Ten pounds brads, wire 1 inch.
Four dozen hinges, brass butt, 2½ inch, with screws.
Four dozen hinges, brass butt, 2 inch, with screws.
Two dozen locks, cupboard.
Two dozen locks, drawer.
Sixty-two pounds nails, No. 6, 8, 10, 12, and 6 and 8 finishing.
Sixty-nine gross wood screws (assorted).
Three gross screws, brass, round head (assorted).
Four reams sandpaper (assorted).
Four handles, plane, for Stanley's adjustable wood plane No. 29.
Four caps, plane, for Stanley's No. 9½.

METAL WORK.

In this work all the different forms in which iron and steel are used in making machinery, and all the different operations which they undergo in taking such forms, are simplified and used as exercises.

The work consists of blacksmithing and bench work, and a course is pursued whereby the pupil may secure the experience and training most necessary and essential.

The first step for the beginner is bench work, where he becomes familiar with the use of the hammer, chisel, and file. Here the



SAMPLES FROM THE METAL-WORKING CLASS.

(Philippine School of Arts and Trades.)

pupil receives his first instructions in the importance of working accurately.

The benches in the different schools vary according to the class of work to be done. The illustration shown herewith represents a bench for chipping and filing. The dividing screen in the center prevents the flying chips from hitting the pupil on the opposite side. A strong, substantial vise is secured at each corner. The single drawer is the tool drawer and contains a hammer, chisel, square, file card, calipers, and whatever tools the teacher may decide upon as class tools. The two rows of drawers in the center are for files and the finished work. One drawer is assigned to each pupil, and should be kept locked.

The first exercise should be chipping a rough casting, and the teacher should explain fully to the class the nature of the scale or outer covering. He should impress upon them the necessity of first removing this scale with a chisel before filing. He should also explain when to use the different chisels, the proper angles at which they should be ground and the temper required for various metals.

After the scale has been removed and the piece ready to file, the teacher should briefly describe a file and its care. At this time it is not necessary to explain all the different kinds of files, for it is liable to confuse the pupil, but as the different exercises appear it will be well to explain each file used and its special advantages.

The work should be of such a variety as to require the use of different files, and at the end of the term an examination should be held to ascertain the pupil's knowledge of a file as well as his ability to use one.

Each exercise should be made from a drawing, and proper instructions should be given in laying out work both in the rough and semifinished condition.

A small amount of drilling and tapping may be introduced, but it is not necessary to do very much of this work.

When pieces of work are finished they should be well oiled to prevent rust, and marked in some manner so that each student's work may be identified.

In bench work the pupil learned to use the hammer and direct the blow where he desired. In blacksmithing this will be of great assistance to him, but he has another difficulty to overcome—that of holding the tongs with his left hand.

In this department he becomes familiar with the different methods of forming and uniting metals. He will study the properties of the same and the degrees of heat each requires.

Unless a student desires to make blacksmithing his trade or special study, one year should be sufficient to give him a fair knowledge of the subject. The course should be so constructed as to require the use of all the different tools used in general work. Throughout the course accuracy should be sought in all cases.

When the class consists of both blacksmithing and bench work it should be provided with three benches and four forges. With four boys at each bench and two at each forge a class of 20 could be accommodated.

EQUIPMENT FOR METAL WORKING SHOPS.

Two dozen files, flat, bastard, 12 inch.
Two dozen files, hand, second cut, one safe edge, 10 inch.
Two dozen files, half round, bastard, 12 inch.
Two dozen files, half round, smooth, 10 inch.
Two dozen files, square, bastard, 8 inch.
Two dozen files, round, smooth, 8 inch.
Twelve dozen file handles, assorted.
Twelve vises.
Five dozen hack-saw blades, 12 inch.
One dozen $\frac{1}{16}$-inch drills, twist.
One dozen $\frac{1}{8}$-inch drills, twist.
Six drills, $\frac{3}{16}$ inch.
Three drills, $\frac{7}{32}$ inch.
Three drills, $\frac{1}{4}$ inch.
Three drills, $\frac{9}{32}$ inch.
Three drills, $\frac{5}{16}$ inch.
Three drills, $\frac{11}{32}$ inch.
Three drills, $\frac{3}{8}$ inch.
Three drills, $\frac{13}{32}$ inch.
Three drills, $\frac{7}{16}$ inch.
Three drills, $\frac{1}{2}$ inch.
One set taps and dies with 6-inch stock and tap wrench for machine screws, Nos. 4, 6, 8, 10, 12 (duplicate taps).
One countersink, $\frac{1}{2}$-inch round shank.
One grindstone, "Samson," No. 1.
One emery oilstone, $7\frac{1}{2}$ by 2 by $1\frac{1}{4}$ inches.
One dozen bench brushes.
One dozen malleable iron oilers, 2 gills.
One hammer, riveting, 9 ounce.
One set twist drills, 1 to 60.
One screw-driver set with 3 screw-driver bits.

One paragon cutting plier, flat nose, 6 inch.

One lightening screw plate, 6 sizes taps and dies, $\frac{3}{16}$ to $\frac{1}{2}$ inch, 18-inch stock.

One post drill.

One blacksmith's friction drill, chuck to be fitted with $\frac{1}{2}$-inch arbor.

One metric micrometer, 25 millimeters, with lock nut and ratchet stop, in leather case.

One universal bevel, 3 inch.

One screw pitch gauge.

One hack-saw frame.

One universal surface gauge.

One thread caliper, 4 inch.

One universal divider.

One steel wire gauge.

One dozen steel rules (metric, 15 centimeters).

One dozen solid steel squares, 3-inch blade.

One dozen scribers.

One dozen outside calipers, spring nut, 4 inch.

One dozen inside calipers, spring nut.

One dozen spring dividers, spring nut, 4 inch.

One dozen center punches.

One dozen hammers, ball pein, 1 pound 4 ounces.

One dozen cold chisels, $\frac{3}{4}$-inch cut, $\frac{5}{8}$ by 10 inch, octagon steel.

One dozen cape chisels, octagon steel, $\frac{3}{8}$-inch cut.

One dozen file cleaners.

One-third dozen Eagle anvils, 150 pounds.

One-third dozen portable Champion forges.

One-third dozen hammers, hand, 2 pound.

One-third dozen sledge hammers, 8 pound, cross pein.

One-third dozen cold chisels, 2 pound.

One-third dozen hot chisels, 2 pound.

One-third dozen bottom swages, 2 inch, $\frac{1}{2}$ inch, $\frac{3}{4}$ inch, 1 inch.

One-third dozen top swages, 2 inch, $\frac{1}{2}$ inch, $\frac{3}{4}$ inch, 1 inch.

One-third dozen flatters, $2\frac{1}{2}$ inch.

One-third dozen bottom fullers, 2 inch, $\frac{1}{2}$ inch, $\frac{3}{4}$ inch, 1 inch.

One-third dozen top fullers, 2 inch, $\frac{1}{2}$ inch, $\frac{3}{4}$ inch, 1 inch.

One-third dozen hardies, $1\frac{3}{4}$ inch.

Shanks of bottom fuller, bottom swages, and hardies, to fit holes in anvil, $\frac{3}{4}$ inch.

Two vises, 5-inch jaws, 65 pounds.

Sixteen blacksmith's tongs, 22 inch.

Eight blacksmith's gad tongs, 22 inch.

One-third dozen steel squares, $1\frac{1}{2}$ inches wide, $\frac{1}{8}$ inch thick, 12-inch body, 8-inch tongue.

Thirty pounds cotton waste.

One quart slush oil.

SUGGESTIVE LIST OF USEFUL EXERCISES.

- Bench block.
- Lap joint.
- Sliding fit.
- Dovetail joint.
- Solid tap wrench.
- Cross-pein hammer.
- Parallel clamp.
- Rapping calipers.
- Surface gauge.
- Spring calipers.
- Spring dividers.
- Adjustable tap wrench.
- Fire poker.
- Harness hook.
- Angle iron.
- Eye bolt.
- Swivel.
- Chain.
- Cape chisel.
- Flat chisel.
- Center punch.
- Ball-pein hammer.
- Tongs.

COURSES IN MECHANICAL DRAWING AND WOODWORKING.

FIRST YEAR.

Mechanical drawing:
- Care and use of instruments.
- Plane geometry—
  - Bisections.
  - Perpendiculars.
  - Tangents.
  - Polygons.
- Orthographic projection—
  - Principles.
  - Projections of geometric solids.
  - Revolution on axes.
- Practical applications—
  - Working drawings of objects to be constructed of wood in the shop.
  - Floor plans.
- Inking.
- Lettering.
- Free-hand drawing.

Woodworking:
- Names, care, and use of tools.
- Reading working drawings.
- Measuring exercises.
- Laying out work with try-square and knife, bevel gauge and knife, marking gauge.

Woodworking—Continued.
- Planing—
  - Plane surfaces.
  - Edge jointing.
  - To gauge lines.
  - Chamfering.
  - Block planing.
- Rip and crosscut sawing to dimensions.
- Paring with chisel to line—
  - Right angle and oblique to grain.
  - Chamfering.
  - Curved surfaces.
- Grinding edge tools and whetting same on oilstone.
- Fastening work together with—
  - Nails.
  - Screws.
  - Glue.
- Sandpapering.
- Shellacing.
- Varnishing.

SECOND YEAR.

Plane geometry:
- Ellipse.
- Conchoid, with applications.
- Columns.
- Arches, etc.

Orthographic projections:
- Cutting planes.
- Intersection of solids.
- Development of surfaces.

Isometric projection.

SECOND YEAR—continued.

Plans and elevations of wooden houses, and details of construction.

Inking.

Lettering.

Tracing.

Blue printing.

Free-hand drawing.

Principles of joinery:
- Halved "T" joint.
- Cross lap joint.
- Open mortise-and-tenon joint.
- Blind mortise-and-tenon joint.

Principles of joinery—Continued.
- Brace joints.
- Blind mortise-and-tenon brace joints.
- Dowel joints.
- Mitre joints.
- Dovetail joint.
- Half-blind dovetail joint.
- Scarf joint and modifications.

Paneling.

Rabbeting.

Beading.

COURSES IN MECHANICAL DRAWING AND IRON WORKING.

FIRST YEAR.

Drawing:
- Care and use of instruments.
- Plane geometry—
  - Bisections.
  - Perpendiculars.
  - Tangents.
  - Polygons.
- Orthographic projections—
  - Principles.
  - Projections of geometric solids.
  - Revolution on axes.
- Practical application: Working drawings of objects to be constructed of iron or steel in the shop.
  - Inking.
  - Lettering.
  - Free-hand drawing.

Bench work:
- Chipping grooves with cape chisel.
- Chipping with flat chisel.
- Filing flat surfaces.
- Filing surfaces at right angles and testing with try-square.
- Chipping and filing curved surfaces.
- Filing parallel surfaces and testing with calipers.

Fitting pieces in groove.

Key-seat chipping.

Use of hack saw.

Use of die plate.

SECOND YEAR.

Plane geometry:
- Ellipse.
- Conchoid, with applications.
- Helix.
- Columns.
- Arches, etc.

Orthographic projection:
- Cutting planes.
- Intersection of solids.
- Development of surfaces.

Isometric projection.

SECOND YEAR—continued.

- Working drawings of tools and machinery.
- Lettering.
- Tracing.
- Blue printing.
- Free-hand drawing.
- Blacksmithing:
  - Names and uses of tools.
  - Inking.
- Blacksmithing—Continued.
  - Care of fire.
  - Hammer exercises.
  - Bending.
  - Forging simple articles from iron.
  - Scarfing.
  - Welding
  - Forging tool steel.
  - Tempering the same.

WOODS FOR TRADE SCHOOL USE.

It is advised that native woods be used exclusively for trade school work. In many places this rule will be followed from sheer necessity, but in other places it should be followed as well.

As the timber resources of the Islands are developed it seems probable that, in the near future, very little lumber will be imported. At the present time there are many varieties on the market which rival the woods of South America and other places in their beauty, strength, and utility.

Narra and tindalo.—Among those best known are narra and tindalo. These are usually very beautiful, are capable of taking a fine polish, and are excellent for furniture and all decorative purposes. Narra has a "curly" grain and is very hard to work, but tindalo is more easily manipulated.

Palo maria.—Another wood with a beautiful grain is palo maria. This wood stains and polishes easily, is not difficult to work, and ought to be used more than it is for cabinets and furniture.

Amuguis.—Amuguis is another good wood for cabinet work. It works easily and does not warp when seasoned. It has a very coarse, open grain.

Acle.—Acle is a dark wood like black walnut, but is much harder and has a coarse grain. It takes a good polish.

Guijo.—Guijo, similar to the red birch of America, is very strong. This wood warps and shrinks a great deal.

Baticulin.—Baticulin is one of the best woods for carving purposes. It has a "clean" grain, is quite soft, and does not check. It is a flesh color.

Lauan.—Lauan is a very fine wood for school exercises. It is soft and very easily worked on account of its "clean" grain. In appearance it resembles ash, with a color something like oak. This wood is very good for drawing boards and for cabinet work. It is readily stained.

Banuyo.—Banuyo might be called a yellow mahogany. It is a very clean-working wood.

Cupang.—Cupang is a very soft wood, not very strong. This ought to be a very good wood for class exercises.

It is recommended that all teachers of woodwork experiment with the native woods to be found in their districts and that samples of wood in their natural and finished condition be submitted to the committee, together with the observations made. This last matter is of the greatest importance and should receive the most careful consideration of the teachers engaged in this branch of work.

BOOKS ON INDUSTRIAL WORK.

The following books have been ordered and can be had by making requisition on the General Superintendent, Bureau of Education: Handbook of Sloyd, by Otto Saloman; The Sloyd System, by B. B. Hoffman; Sloyd, or Educational Manual Training, by E. Schwartz; Exercises in Woodwork, by I. Sickles; Cardboard Construction, by J. H. Trybom; How to Make Baskets, by Mary White; Mechanical Drawing, by Linus Faunce; Mechanical Drawing, by J. C. Tracy; Mechanical Drawing, by Frank Aborn; Free-Hand Lettering, by F. C. Brown.

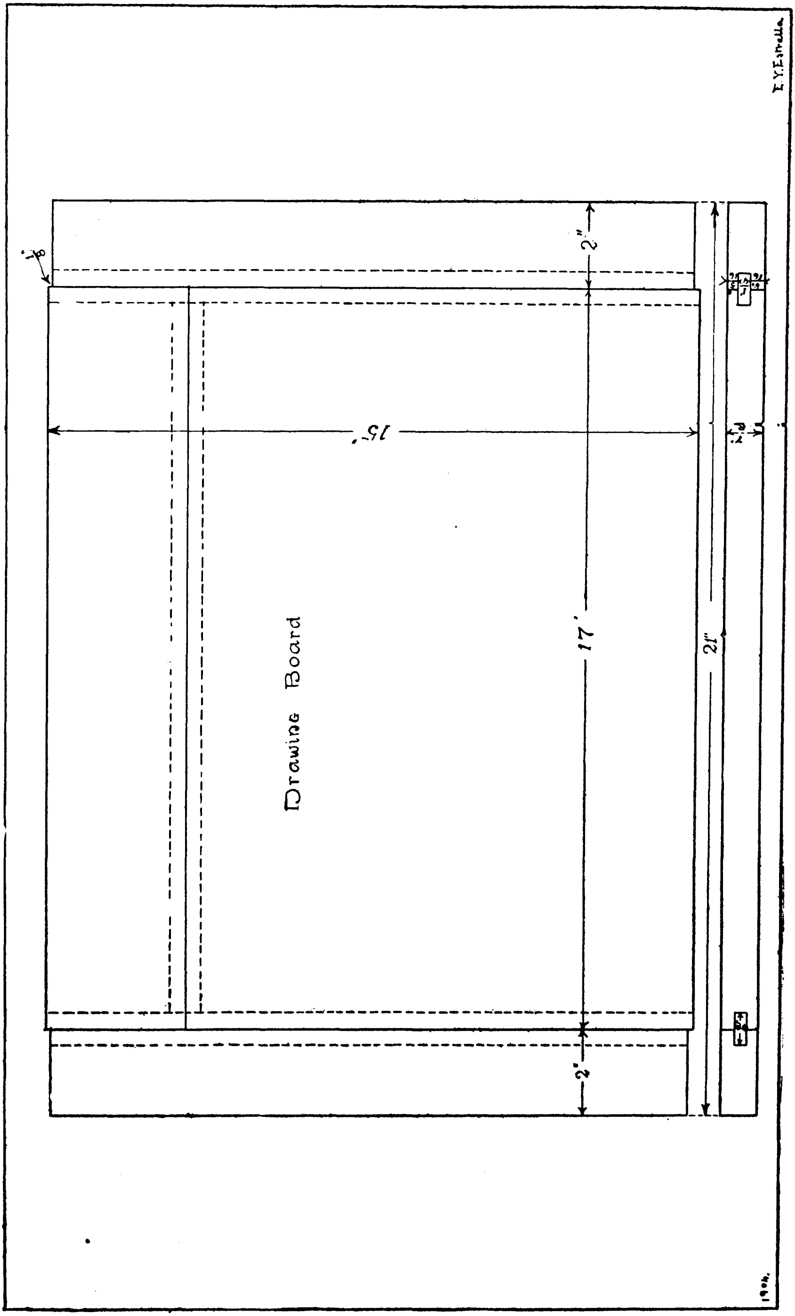
ILLUSTRATIONS.

DRAWING BOARD.

Material.—Lauan.

Dimensions.—Stock, $\frac{7}{8}$ inch thick. Finished board, 15 by 21 inches.

Description.—Grain of center board to run in direction of length. Cross pieces to be tongued and grooved and fastened to center piece with screws; not glued. End pieces to be cut in $\frac{1}{8}$ inch from edge at end.



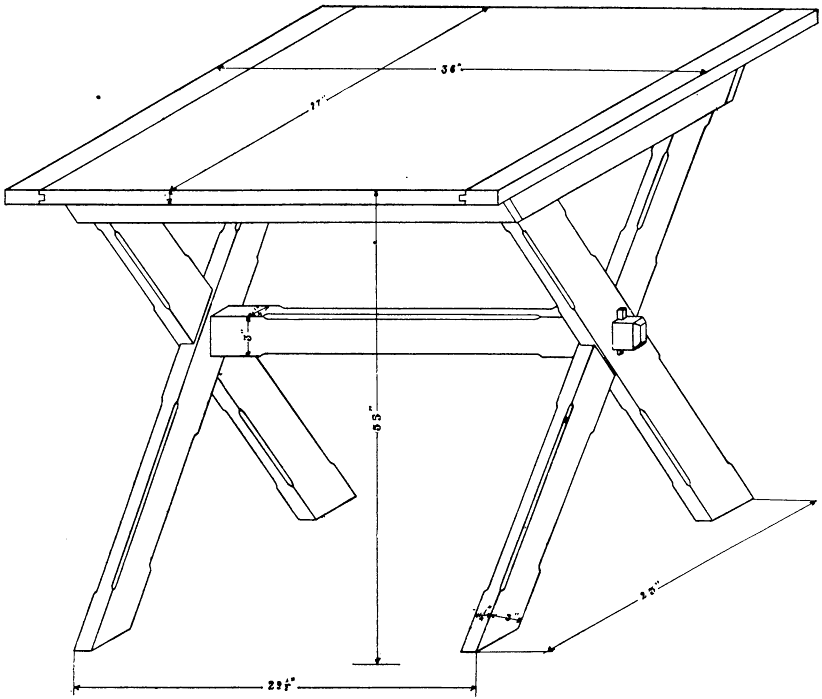
Woodwork. (Sheet No. 21.)

DRAWING TABLE.

Material.—Lauan, amuguis.

Dimensions.—Top, ⅞ inch thick, 27 inches wide, 36 inches long; total height, 35 inches; stock for frame, 1¼ by 3 inches.

Description.—Legs halved together but not flush. Keyed mortise-and-tenon joints on crosspiece. No shelf.



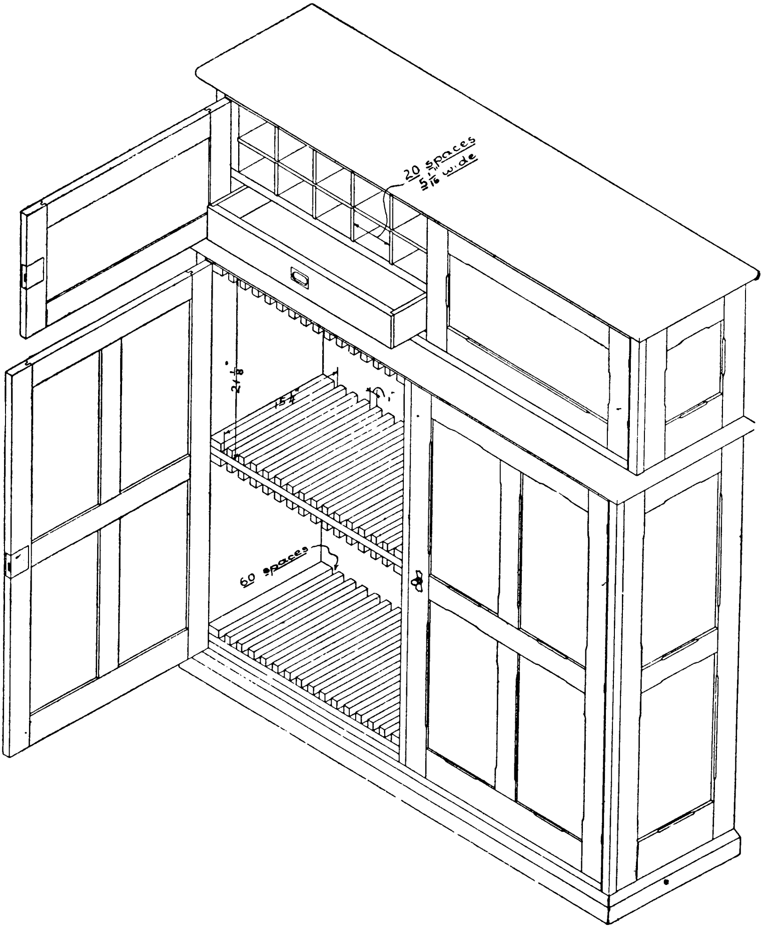
Drawing table. (By Serapio Francisco.)

DRAWING BOARD AND INSTRUMENT CABINET.

Material.—Lauan, amuguis.

Dimensions.—Panels, $\frac{1}{2}$ inch thick. All other materials $\frac{7}{8}$ inch thick.

Description.—Spaces for instruments, $5\frac{1}{16}$ inches wide, $12\frac{1}{4}$ inches deep. Space on door side of drawer for clearance when door is not fully opened, $1\frac{1}{2}$ inches. Spaces in each half of lower cabinet for thirty boards. Clearance between front of board rack and door when closed, 1 inch. Bottom of lower rack 1 inch above bottom of door. Side strips of racks to be $1\frac{1}{2}$ inch, to give room for handling end boards, especially when door is not fully opened.



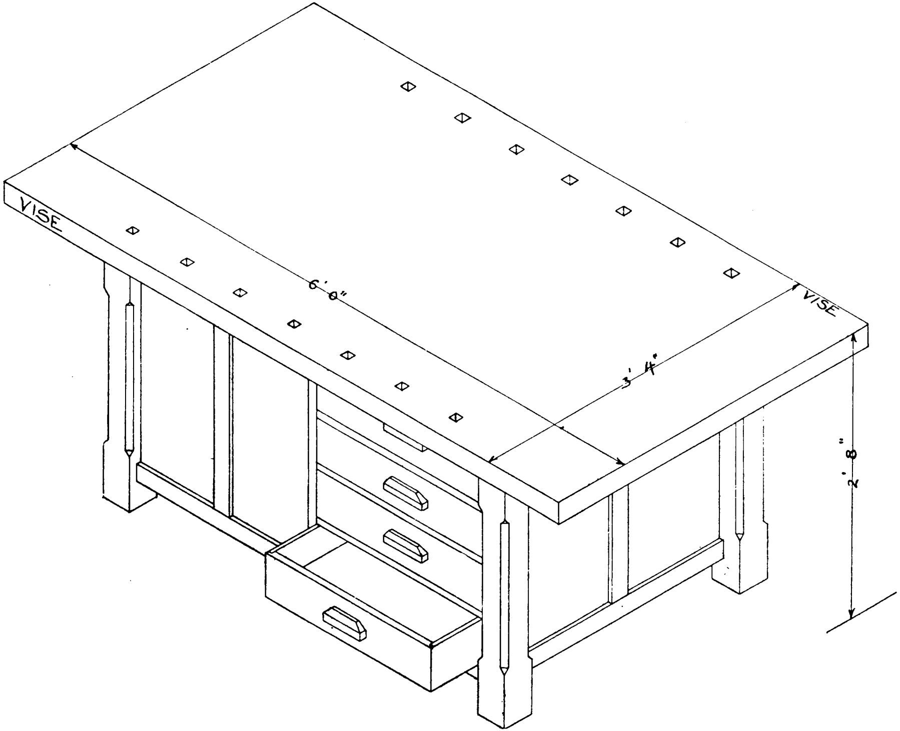
Combination drawing board and instrument cabinet.

CARPENTER BENCH.

Material.—Top: Ipil, tindalo, narra, or molave. Posts, panels, and drawers: Lauan, amuguis.

Dimensions.—Top, 2½ inches thick. Posts, 3½ inches square. Panels, ½ inch thick. Framing, ⅞ inch thick.

Description.—Top mortised to posts and projected at ends 10 inches for vises. Four drawers, one for tools used in common, three for individual tools.



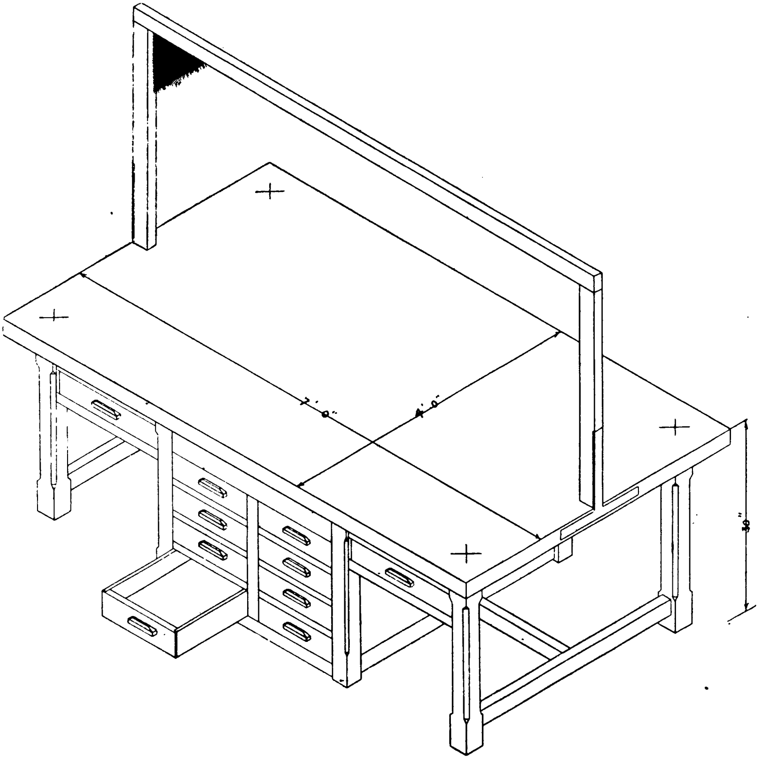
Carpenter bench for two pupils. (By Estevan Reyes.)

MACHINIST BENCH.

Material.—Top: Ipil, tindalo, narra, or molave. Posts, panels, and drawers: Lauan, amuguis.

Dimensions.—Top, 2½ inches thick; posts, 3½ inches square; panels, ½ inch thick; framings, 1½ inches.

Description.—"X" indicates location of vise over post. Vise to be fastened with lag screws. Single drawer for tools used in common. Rows of drawers for individual use. In center of bench, running long way, a wire screen of fine mesh to check flying chips. Height of screen, 36 inches.



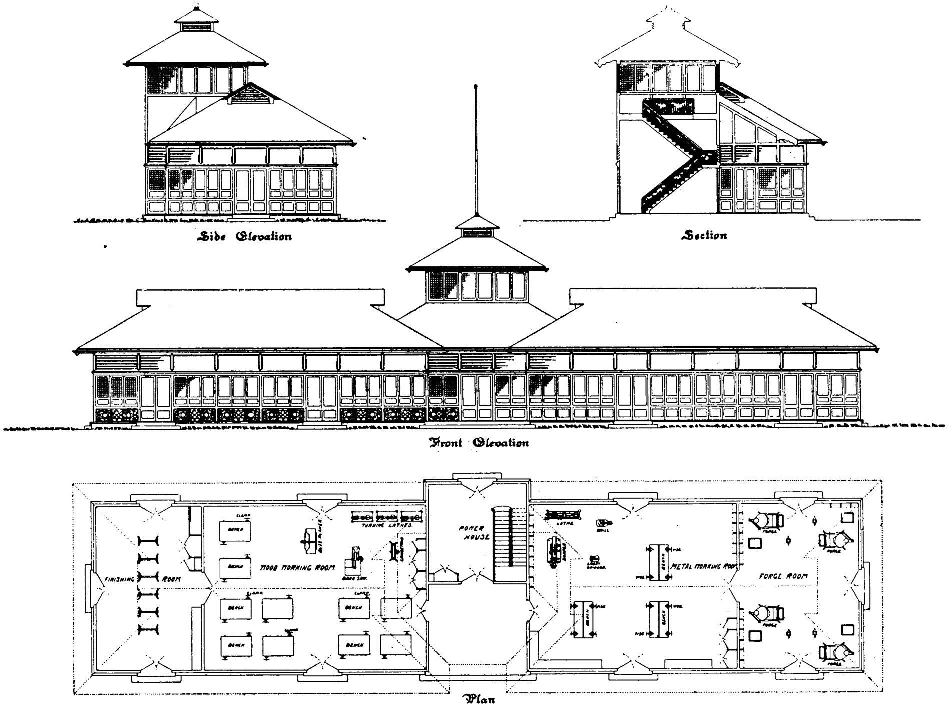
Machinist bench for four pupils.

WOOD AND IRON WORKING SHOPS.

The sketch shown on the opposite page represents a building to be devoted entirely to work in these two trades. It is divided into three distinct parts, all parts of such a shape and character that they may be erected at different times as funds and circumstances will permit. The central portion contains all the machinery, boilers, and other mechanism necessary to generate the power to be used in the school. This room projects slightly to the rear, thus admitting plenty of light. On the front is an open vestibule which not only adds to the appearance of the building but serves as a "wind-catcher," thus assuring good ventilation. Whether electricity, oil, or steam is to be used for motive power is a problem for the local authorities to solve. This part of the building is separated from each wing by a dead wall. One wing is devoted entirely to metal working, the other to woodworking. Each wing is divided into two rooms, thus making a well-balanced building. The larger room on the woodworking side is 30 feet wide by 50 feet long. It is well lighted on the sides of greatest length by sliding shell windows, while at the top are a series of louvres. Thus a large, well-lighted and well-ventilated room is provided, wherein may be located a band saw, a buzz planer, two wood-turning lathes, a grindstone, and ten double benches fully equipped with bench tools. In addition, space is provided for the proper assembling of a cart, a small launch, furniture, or such other articles as may be made. Connected with this large room by a 6-foot doorway is a finishing room. This room is at the extreme end of the building, separated as far as possible from the dirt and dust of the shop. Here an even temperature may be obtained, and painting, varnishing, and polishing carried on under proper conditions. In the other end of the building is a similar arrangement of rooms. The larger one will contain one lathe for metal work, one upright drill, one shaper, and one emery wheel, in addition to three quadruple benches fitted out with files, hammers, squares, calipers, and other hand tools necessary for the proper manipulation of various metals. The accompanying sketch shows how these tools and benches may be arranged with the best results. Adjoining this last room and at the end of the building is a blacksmith shop. Four to six forges may be located here, with plenty of space for such special tools as may be required. It is expected that the grills shown in the front elevation will be made in the school.

Extending upward from the center of the building is a square tower, which carries away the accumulation of heat and impure air and at the same time indicates the engineering character of the building.

It is estimated that such a building should cost about $7,000, United States currency.



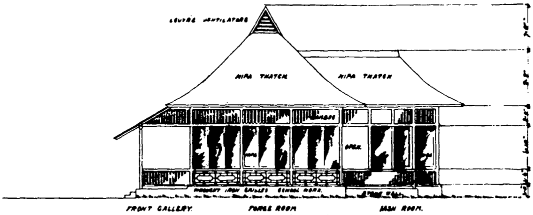
Side Elevation

Section

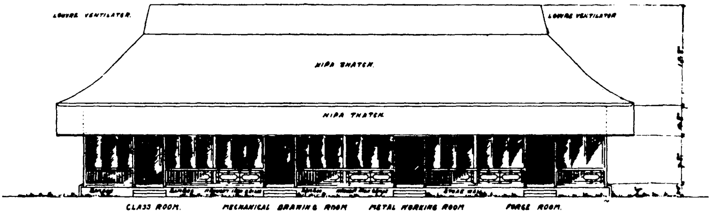
Front Elevation

Plan

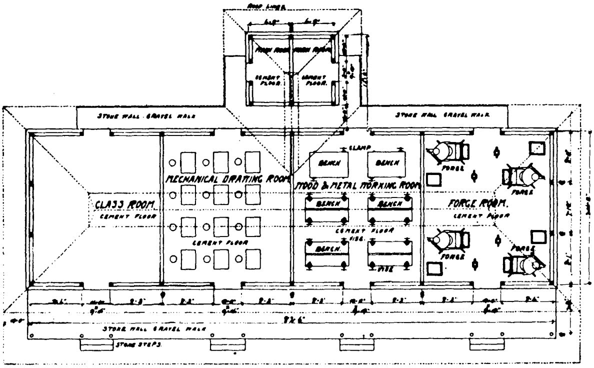
Proposed Plans for Shops for Wood and Metal Working in Provincial Schools



Side Elevation



Front Elevation



Plan

Industrial School at Apalit, Divison of Pampanga & Bataan.